

Patent Application
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IN THE CLAIMS

Please amend the claims as follows:

1. (Thrice amended) A cooling apparatus for removing heat from at least one heat generating component, said cooling apparatus comprising:

a low profile metal unitary member comprised of one piece of metal, said low profile unitary member having a first exterior surface adapted for receiving heat from the at least one heat generating component and having a plurality of micro tubes formed of said one piece of metal having a flattened heat transfer surface, said low profile metal unitary member having a micro tube inlet comprised of said one piece of metal and a micro tube outlet comprised of said one piece of metal, said low profile metal unitary member providing an entirely metallic thermal path for conducting heat from said first exterior surface to a heat transfer fluid contained within said plurality of micro tubes;

an inlet tube;

an[d] inlet end cap interconnecting the micro tube inlets in fluid communication and connecting the micro tube inlets in fluid communication with said inlet tube;

an outlet tube;

an outlet end cap interconnecting the micro tube outlets in fluid communication and connecting the micro tube outlet in fluid communication with said outlet tube;

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said low profile metal unitary member being sealed by a first seal and a second seal for enclosing said low profile metal unitary member, said first seal being formed at said inlet end cap, said second seal being formed at said outlet end cap, said first seal forming a first seal length and said second seal forming a second seal length; each of said plurality of microtubes being fluidly connected to adjacent and non-adjacent microtubes via said inlet end cap and said outlet end cap;

means for circulating said heat transfer fluid through said inlet tube, said inlet end cap, the plurality of micro tubes of said low profile metal unitary member[extrusion], said outlet end cap, and said outlet tube; and

means for removing heat from said heat transfer fluid.

2. (Twice Amended) The cooling apparatus of claim 1, wherein said [low profile metal member is formed from a single piece] first seal and said second seal are formed by welding.

3. (Amended) The cooling apparatus of claim 2, wherein said member is in thermal contact with said at least one heat generating component, and said member is further in direct contact with said heat transfer fluid.

4. (Amended) The cooling apparatus of claim 2, wherein said low profile metal member is plated on an exterior surface with a metal material.

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5. The cooling apparatus of claim 1, further comprising at least one thermoelectric cooling unit disposed between said at least one heat generating component and said first exterior extrusion surface.

6. (Amended) The cooling apparatus of claim 1, wherein said low profile metal member further comprises a plurality of fins on a second exterior surface opposite said first exterior surface adapted for receiving heat.

7. (Amended) The cooling apparatus of claim 1, wherein said low profile metal member further comprises a plurality of fins or grooves on an interior surface of each of said plurality of micro tubes.

8. (Amended) A cooling apparatus for removing heat from at least one heat generating component, said cooling apparatus comprising:

a low profile unitary member having a flattened exterior extrusion surface adapted for receiving heat from the at least one heat generating component and a plurality of micro tubes with a micro tube inlet and a micro tube outlet;

at least one fin on an interior surface of at least one of said plurality of micro tubes;

means for circulating a heat transfer fluid through said plurality of micro tubes of said low profile member, and

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means for removing heat from said heat transfer fluid.

9. The cooling apparatus of claim 8, wherein each of said micro tubes are substantially rectangular in shape.

10. (Amended) The cooling apparatus of claim 8, wherein said low profile member is formed of a metal material.

11. The cooling apparatus of claim 10, wherein said metal material is in thermal contact with said at least one heat generating component, and said metal material is further in direct contact with said heat transfer fluid.

12. The cooling apparatus of claim 8, further comprising at least one thermoelectric cooling unit disposed between said at least one heat generating component and said first exterior extrusion surface.

13. (Amended) The cooling apparatus of claim 8, wherein said low profile extrusion further comprises at least one fin on an interior surface of each of said plurality of micro tubes.

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21. (Twice Amended) A cooling apparatus for removing heat from at least one heat generating component, said cooling apparatus comprising:

a low profile metal unitary member comprised of one piece of metal having a first exterior extrusion surface adapted for receiving heat from the at least one heat generating component and a plurality of micro tubes with a micro tube inlet comprised of said one piece of metal and a micro tube outlet comprised of said one piece of metal, said low profile metal unitary member providing an entirely metallic thermal path for conducting heat from said first exterior extrusion surface to a heat transfer fluid contained within said plurality of micro tubes, said member having a profile of less than approximately 0.1 inches;

an inlet end cap interconnecting the micro tube inlets in fluid communication;

an outlet end cap interconnecting the micro tube outlets in fluid communication;

said low profile metal unitary member being sealed by a first seal and a second seal for enclosing said low profile metal unitary member, said first seal being formed at said inlet end cap, said second seal being formed at said outlet end cap, said first seal forming a first seal length and said second seal forming a second seal length;

each of said plurality of microtubes being fluidly connected to adjacent and non-adjacent microtubes via said inlet end cap and said outlet end cap;

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means for circulating said heat transfer fluid through said inlet end cap,
the plurality of micro tubes of said low profile extrusion and said outlet end cap; and
means for removing heat from said heat transfer fluid.

22. The cooling apparatus according to claim 21 wherein:

said cooling apparatus is affixed to a printed circuit board for cooling said heat
generating component.

23. The cooling apparatus according to claim 1 wherein:

said cooling apparatus is affixed to a printed circuit board for cooling said heat
generating component.

24. The cooling apparatus according to claim 8 wherein:

said cooling apparatus is affixed to a printed circuit board for cooling said heat
generating component.

25. The cooling apparatus according to claim 1, wherein each of said micro
tubes are polygonal in cross section.

26. The cooling apparatus according to claim 1, wherein each of said micro
tubes are substantially square in cross section.

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27. The cooling apparatus according to claim 8, wherein said micro tubes are polygonal in cross section.

28. The cooling apparatus according to claim 8, wherein said micro tubes are substantially square in cross section.

29. The cooling apparatus according to claim 21, wherein said micro tubes are polygonal in cross section.

30. The cooling apparatus according to claim 1, wherein said micro tubes are substantially square in cross section.

31. The cooling apparatus according to claim 21, wherein said micro tubes are substantially square in cross section.

32. The cooling apparatus according to claim 1 wherein:
said member has a profile of approximately 0.1 inches.

33. The cooling apparatus according to claim 8 wherein:
said member has a profile of approximately 0.05 inches.

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34. The cooling apparatus according to claim 1, wherein said micro tubes have a diameter of between approximately .0625 inches and 0.5 inches.

35. The cooling apparatus according to claim 8, wherein said micro tubes have a diameter of between approximately .0625 inches and 0.5 inches.

36. The cooling apparatus according to claim 21, wherein said micro tubes have a diameter of between approximately .0625 inches and 0.5 inches.

37. The cooling apparatus according to claim 21, wherein said low profile is approximately 0.05 inches.

38. The cooling apparatus according to claim 21 further comprising:
at least one fin on an interior surface of each of said plurality of micro tubes.